JIGME NAMGYEL ENGINEERING COLLEGE

DEPARTMENT OF CIVIL ENGINEERING AND SURVEYING

MAGAZINE

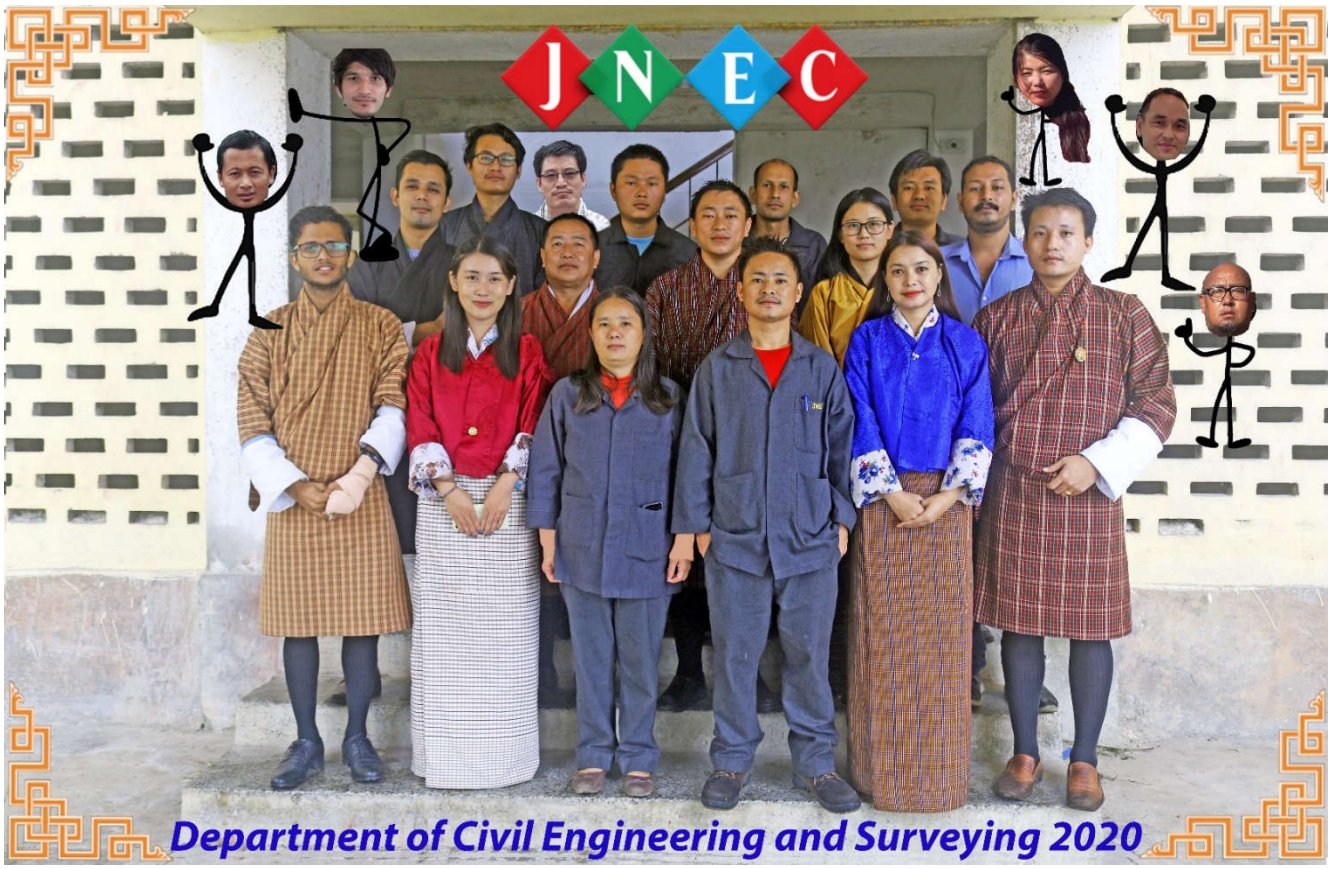
on

GEO-ENVIRONMENTAL EXPO

&

1st DEPARTMENT SEMINAR

Volume II 2021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DEPARTMENT OF CIVIL ENIGINEERING AND SURVEYING

PREFACE

The Department of Civil Engineering and Surveying of Jigme Namgyel Engineering College organized their second Departmental Exhibition themed on, 'Geo-Environmental Exhibition' on 27th April, 2021. The event was graced by Acting President, Deans, Head of Department, staffs and students.

Pel Dueki Khorlo
(*Sanskrit: Kalachakra*)

This year the exhibition was conducted in competitive manner between the students of 1st year Diploma Civil Engineering and 2nd year Diploma Civil Engineering students. 1st Year Diploma students exhibited various models pertaining to solutions of environmental problems such as waste water treatment, waste management, waste water reuse and many other environmental models. On the other hand, second year civil engineering students showcased various geotechnical models demonstrating mechanically stabilized soil blocks, liquefactions, ground stone columns and many other geo-models.

The event was organized and held on Zorig Day (Engineering Day). The National Zorig Day is observed on 27th April 2021 corresponding to the fifteenth day of the third month of the Bhutanese calendar. The day is celebrated across the country as a tribute to all craftsmen, technicians and artists of traditional and modern skills. Further, the event was aimed as a part of academic learning for students to understand and develop engineering ideas for various persisting problems in the society at national level.

The department further conducted its first seminar to provide the platform for students from various programme such as B.E in Surveying and Geoinformatics, Diploma in Civil Engineering, and Diploma in Surveying to gather and share their professional learning experience through the course of semester. Students presented their interesting and innovative learning outcomes gained through various mini-projects or assignments. There were eleven enthusiast volunteering seminar participants. The first department seminar was conducted on 15th of May, 2021. Department aspires to continue the tradition of organizing the seminars and exhibition as an annual event.


GEO
ENVIRONMENTAL
EXPO
Instagram
Jigme Namgyel Engineering College
Liked by Terzaght and 225k others
Jnec_rub Happy Zorig Day!
#zorigpas #engineers #jnec
Geo-Environmental Expo!
Liked by Cassagrande
and 200k others
ZORIG
JNEC # Engineers
Engineering Expo

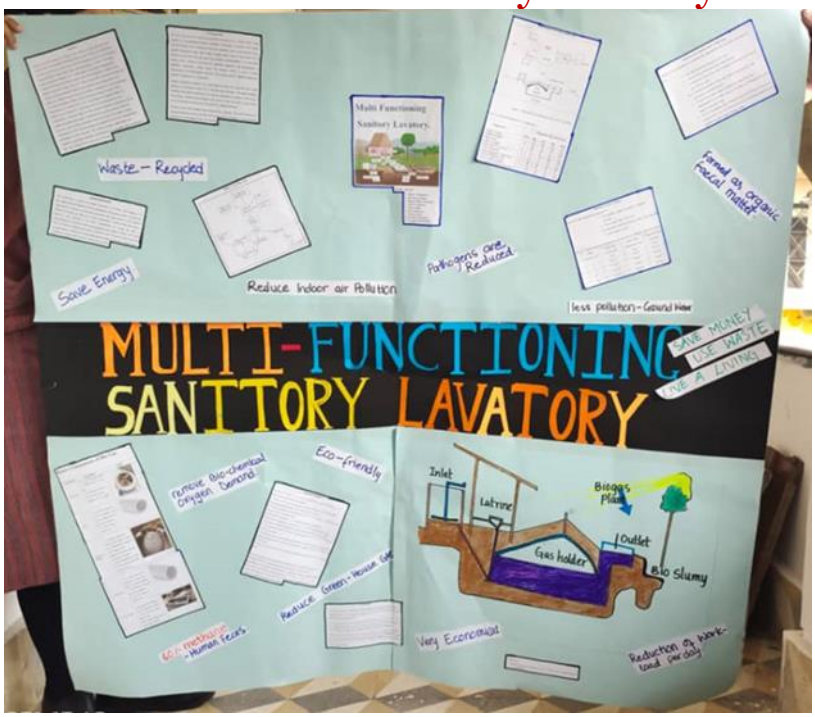
Contents

SECTION-A
ENVIRONMENTAL ENGINEERING MODELS

Waste Water Energy

The idea of the waste water energy is to transform the unwanted waste water into usable one. Waste water includes rain water, industrial waste water, used water from the laundry, bathrooms, kitchen sink etc. So the once used water can be reclaimed and used again for different purposes. The waste water that has been stored in the reservoir will be allowed to flow with high velocity for the generation of low voltage electricity which will be used for charging and lighting purpose. The concept of waste water energy not only solves the water shortage issues but also to generate electricity at low cost.

Multi-Function Sanitary Lavatory



The project is based on the idea to produce biogas for sustainable energy. Bio Gas is the mixture of gaseous produced by breakdown of organic matter in the absence of oxygen (anaerobically), primarily consisting of methane and carbon dioxide. Biogas can be produced from raw materials such as agricultural waste, manure, municipal waste, plant waste, sewage, green waste or food waste but in Bhutan we only have bio gas plant from animal excreta (manure). Bio gas is one of the cheapest and cleanest form of energy. The merits behind the biogas production are not only that it gives extra source of energy; but also eco-friendly and helps in maintaining clean environment. Some of the advantages of using biogas are a) Farmers with two cows can generate sufficient biogas to meet daily basic cooking and lighting needs of the small family in a house. b) Saving of traditional cooking fuel such as firewood (2000 to 3000kg/year) or kerosene (300 to 350liters/year). c) Reduction of greenhouse gasses up to 5 ton of CO2 equivalent per year.

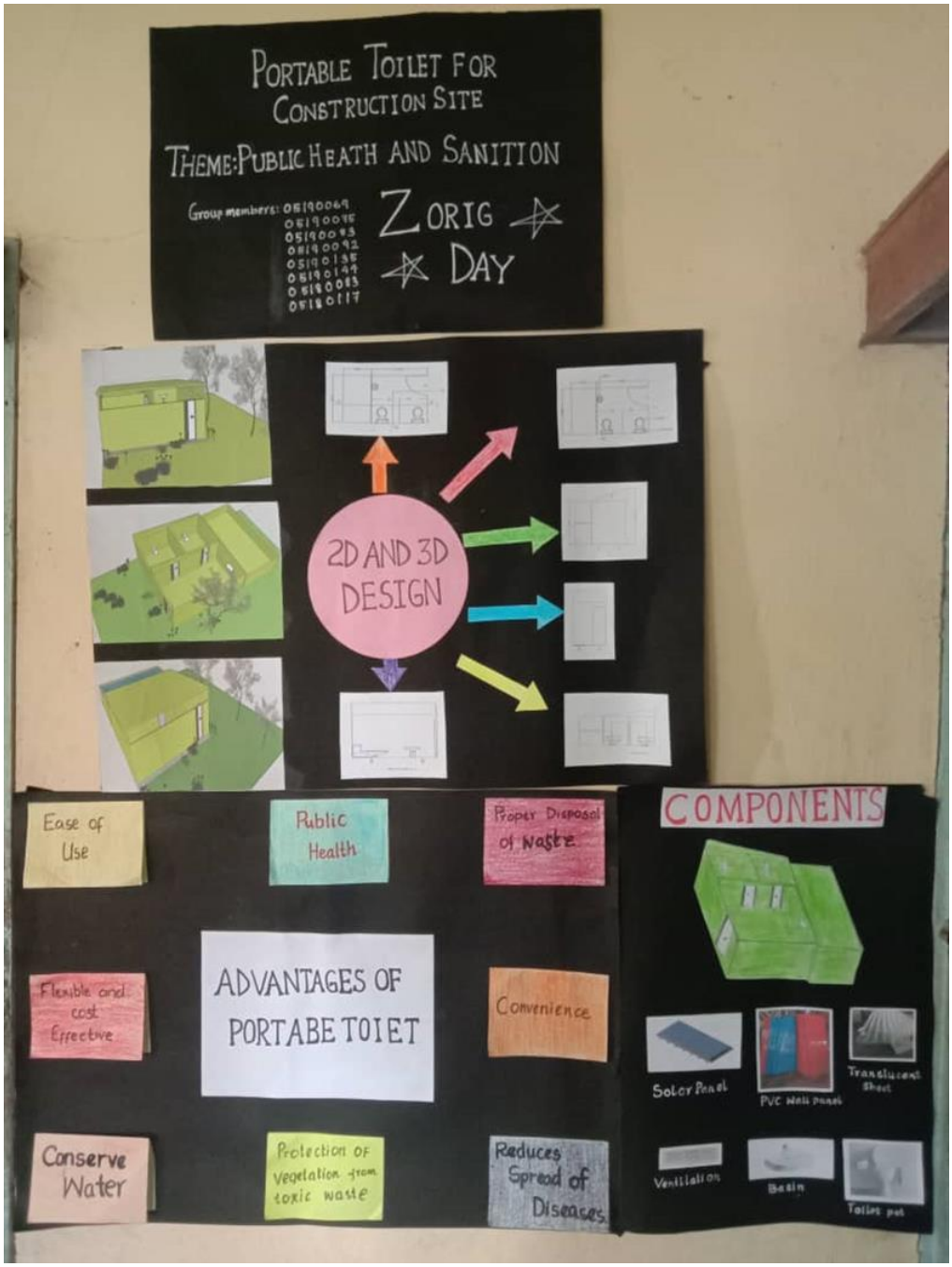
Organic Fertilizer

Wet waste is the main challenge in the present world, tons of kitchen waste is thrown away in the garbage. The waste could be used to prepare a compost out of them, which can be used as a fertilizer. By using the leftovers and other kitchen related waste, they can be converted from smelly items into highly organic product, rich in nutrients that can be used to grow vegetables or flowers. The waste from the kitchen can be collected and used for composting to make fertilizer. The collected kitchen waste can be mixed with orange and banana peels and cover with some grasses and soil for proper decomposition to take place. Then expose it to the sunlight. The process of decomposition will take around two weeks after which the fertilizer can be used for gardening purposes.

Plastic Bricks

Plastics can be made into different shapes when they are heated in a closest environment. Accumulation of plastic waste can result into hazardous effects to both human and environment. The main objective of this project is to use the waste plastics to produce a brick, hence reducing waste pollution and managing the waste properly. Plastic is a good binder which is easy to work with and make into shapes. It also has a low production cost, hence large percentage of plastic waste can be recycled into plastic bricks reducing pollution to a great extent. The strength of a plastic brick is found to be 2.5 times the strength of normal burned clay bricks.

Portable Toilet for Construction Sites



Portable toilet is a modern method or solution to unhygienic outdoor toilet problems in construction site and other relatable areas. A portable or mobile toilet is any type of toilet that can be moved around, some by one person and some by mechanical equipment. Portable toilets are most commonly used at construction sites, outdoor parking lots, and other work environments where indoor plumbing is inaccessible, and at large outdoor gatherings such as concerts, fairs, and recreational events. Portable toilet also plays a vital role in maintaining clean environment in the busy working constructions site. Using portable toilets at construction is advantageous because of its convenience, ease of use and cost effectiveness.

Organic Manure Generator

The main function of organic manure generator is to produce organic manure from the kitchen waste and food waste. With the increasing rate of kitchen waste production, the need of the organic manure generators seems to be mandatory. Organic manure generator is a model designed to collect organic waste of kitchen including food waste, vegetable waste, fruits and egg shells to produce organic manure. Organic manure generator reduces piling up of kitchen waste which in turn reduces the foul smell produced. The kitchen waste is collected in the collector and mixed using manure stirrer and expose it to the sunlight in airtight condition. After around three weeks, waste will turn into manure where different grade of manure can be obtained from the different sieve sizes.

Recycling Grey Water

Grey water is waste water from any household source other than toilet. Grey water makes up roughly 60% of household wastewater. A grey water recycling system uses water primarily from showers and bathtubs. Recycling of grey water can be done by firstly collecting the grey water, then screening of the solid waste from the collected grey water. The grey water that has been screened is filtered and the filtered grey water can be collected and reused for washing, flushing and cleaning purposes. However, this recycled grey water is not recommended for drinking purposes.

Waste Water: From Waste to Resource

Waste production and water pollution are the major problem arising in the generation. Much of our waste water ends up in the river, streams and lakes causing pollution of water bodies. This impact can be reduced to a great extend if the waste water can be treated at individual household. So, wastewater coming from every household can be treated and can be used for different purposes such as washing, cleaning and flushing. Wastewater from kitchen and bath is collected and stored in the reservoir and is mixed with rainwater for dilution. Then the diluted water is taken to aeration unit for further process. Aeration brings water and air in close contact in order to remove dissolved gases. After that, water is filtered into a filtration unit and filtrated water is collected in a reservoir which is connected to tap. Thus the waste water produced at every household can be treated and used for different purposes.

Atmospheric Water Generator

An atmospheric water generator is a device that extracts water from humid ambient air. Water vapor in the air can be extracted by condensation – cooling the air below its dew point, exposing the air to desiccants, or pressurizing the air. Atmospheric water generator consists of compressor, condenser, evaporating coil and capillary tube. The Atmospheric Water Generator works on the same principle as refrigerator and air conditioner. In a cooling atmospheric water generator, a compressor circulates refrigerant through a condenser and then an evaporator coil which cools the air surrounding it. This lowers the air temperature to its dew point, causing water to condense. A controlled-speed fan pushes filtered air over the coil. The resulting water is then passed into a holding tank with purification and filtration system from where water can be collected.

SECTION B
GEOTECHNICAL MODELS

Mechanical Stabilization of soil using Geo-Grid

Soil stabilization is the alteration of soil to enhance their physical properties. Stabilization can increase the shear strength of soil and control shrink-swell properties of the soil, thus improving the load bearing capacity of the sub-grade to support pavements and foundations. Soil stabilization can be utilized on roadways, parking areas, site development projects, embankments and in many other situations where sub-soils are not suitable for construction. The benefits of the soil stabilization includes strength improvement including shearing strength and compressive strength, mitigating volume instability and swelling potential and controlling shrinkage, reducing permeability, and improving durability.

From various ways to stabilize soil, this project is based on mechanical stabilization of soil using Geo-Grid. Soil is the basic foundation to the engineering structures, to strengthen the properties of the soil such as bearing capacity, compressive strength, soil needs to stabilize. Geogrid is the geosynthetic materials used to reinforce soil. This project will mainly show difference in compressive strength of the soil blocks with and without geogrid, as the soil is the available raw material, so by making blocks it can be used in building construction. Besides stabilization of soil is applicable in embankments, in highway constructions, etc.

The average compressive strength for sample Without Geo-Grid = 0.28 N/mm^2

The average compressive strength for sample with 2-layers Geo-Grid = 0.665 N/mm^2

The average compressive strength for sample with 3layers Geo-Grid = 0.94 N/mm^2

Soil Improvement Using Bamboo Fiber

Bamboo, a perennial grass, is one of the rapid thriving grasses which is most abundant in the nature. Usage of bamboo fiber will bind the soil particles together and helps in reduction of rapid change in volumetric properties and ductility behavior.
Advantages of using Bamboo fiber:

- Bamboo fiber will increase the water absorption of the soil.
- Bamboo fiber decreases the maximum dry density of the soil.
- Bamboo fiber will increase the optimum moisture content of the soil.

Extraction of Bamboo Fiber
For our project, as we required only few amount of bamboo fiber, we firstly cut the bamboo from the source and brought it to our work place. Then we hit the bamboo with the hammer and other heavy materials such as stone to get the fiber. Extracting bamboo fiber was tough as no machines or other alternatives were available. For large scale production of bamboo fiber, machines such as Bamboo Shredder are available.

Comparison of Soils
To compare the soil samples, we conducted the Compaction Test (Standard Proctor Test). One test was conducted with natural soil (without bamboo fiber) and another one with the soil containing bamboo fiber. Their results were recorded and compared.

Compressive strength of the bamboo fiber soil block = 5.89 N/mm^2

Soil Liquefaction

Liquefaction occurs when vibrations from seismic waves increase water pressure between soil grains, transforming once cohesive soil into a slurry mud. Liquefaction is more likely to occur in loose to moderately saturated granular soils with poor drainage, such as silty sands or sands and gravels.

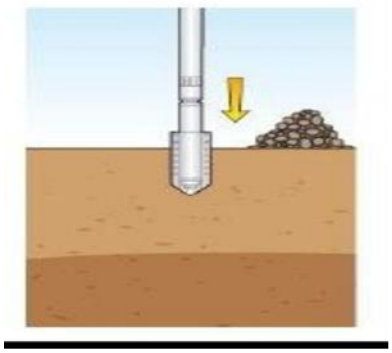
After soil liquefaction has occurred, the soil loses its strength and stiffness often resulting in a variety of structural failures. Hence, a liquefied ground is no longer stable for and fit for construction of structures. It has no ability to take even its self-weight or the weight of structures above. Therefore it is very important to learn about soil liquefaction so that:

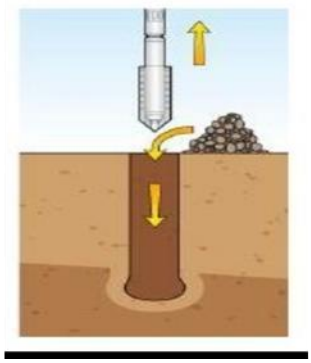
- Adequate precaution is taken before construction of any structures.
- The correct method is chosen to be implemented to make it soil liquefaction free.

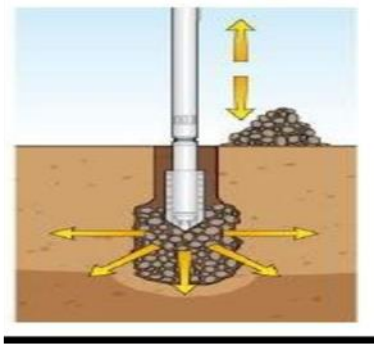
Thus, helps to have stronger and safer construction of structures.

Ground Improvement Using Stone Column

Advantage of Ground Stone Column:
Prevention of soil Liquefaction
Improvement of Soil Bearing Capacity
Increases the Soil Stabilize in De-formation (shear failure)







Lateral Earth pressure/radial Confining stress against bulging from surrounding soil
Frictional resistance developed between column material and weak soil acting upward within the critical length.
Load gets transferred to weak soil and leads to reduction of settlement

Soil Cement Block

Soil is the most commonly available material. It is the basic material for the production of bricks. Burnt brick has been predominantly used in Bhutan. Also, very often they are transported from India. They are produced by employing a burning process and hence consume considerable amount of thermal energy during production. Compacted soil cement block is an alternative to burnt bricks. These blocks can be produced in a decentralized fashion employing simple manually operated or semi-mechanized presses utilizing local soil. Also, these blocks are economical and consume less thermal energy during production.

The following points are clear regarding the soil-cement block technology.

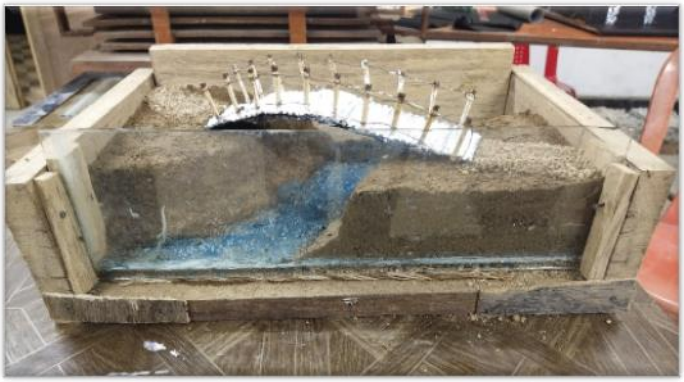
(a) There is a steady progress in the use of soil-cement blocks for building construction in several parts of the world. Pressed soil-cement blocks can be produced in a decentralized manner utilizing local soils and local labor.

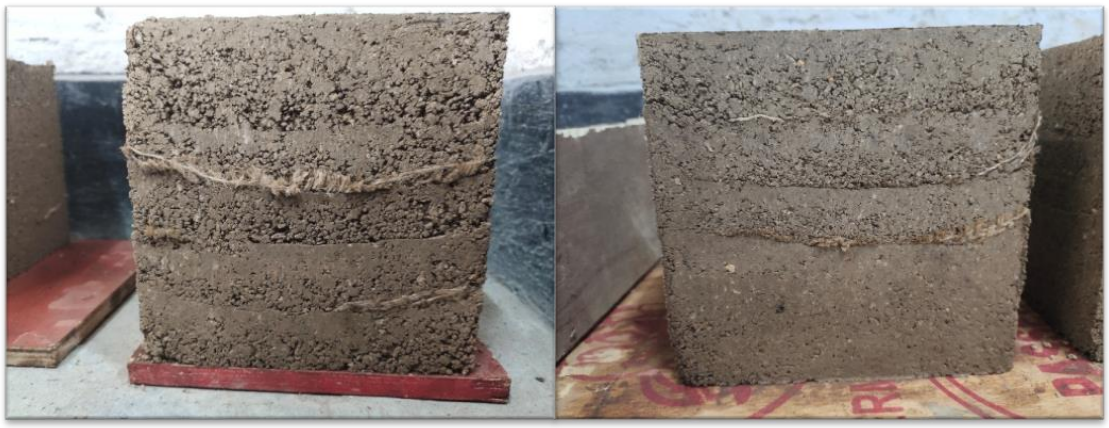
(b) The strength and durability characteristics of soil-cement blocks mainly depends upon soil composition, block density and cement content. Soils containing predominantly non-expansive clay minerals with 60 -70% sand, and <15% clay size fractions are ideally suited for soil-cement block production.

(c) Soil-cement blocks are energy efficient compared to conventional materials such as burnt bricks. They consume only 25 -30% energy used for the production of burnt bricks. Hence, wide use of soil-cement blocks can lead to considerable savings in energy resources.

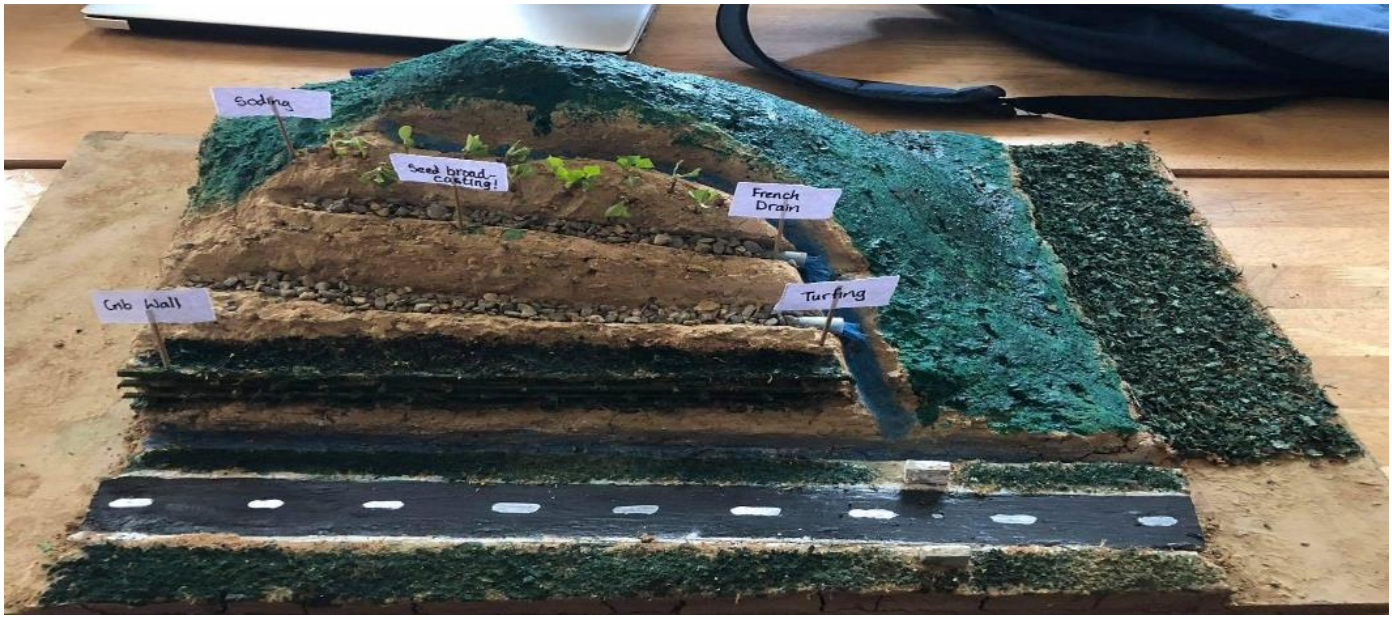
Mechanically Stabilized Soil

Introducing reinforcement elements (synthetic or natural fibers) in soil mass enhance its engineering properties such as stability and strength. The factors that decide the effectiveness of the structure build using reinforced soil is placement method of reinforcing element, failure surface of reinforcing elements and the stress transfer between the soil and the reinforcement.In this mini-project we experimented on which reinforced soil block (with reinforcement elements provided at top, middle, bottom and at equal layers) will have greater stability and strength. The result obtained after the compressive strength test was that providing maximum number of reinforcements with equal spacing will give soil a higher strength thereby increasing the bearing capacity of a loose soil. In order to demonstrate or to show the application of reinforced soil we explained by constructing a mini bridge abutment.





Rehabilitation of Soil with Bio-Engineering



Bioengineering is the application of the life science, physical science, mathematics and engineering principles to define and solve problems in biology, medicine, health care and other fields. The intention of this mini projects revolves around applying bioengineering to rehabilitate the soil and to develop better idea to avoid further slope failure. The term rehabilitation refers to restoration of anything to its actual form. Here, rehabilitation of soil refers to restoration of failed hillock or the slope to avoid further failure and also to provide firm appurtenances to that place.

Bioengineering is the discipline dealing with physics ,mathematics and biology to improve health, life style, and engineering designs and structures. In this mini project, the target of implementing bioengineering techniques is to rehabilitate the slope failure. Various bioengineering techniques such as sodding, turfing and seed broadcasting are used to achieve the demonstration of avoiding the slope failure. Also, the special drain called French drain is used to retain the soil and to drain out the water without hampering the work being done in the place.

In addition to those mentioned above, the bamboo crib retaining wall us placed at the base of the hillock which functions to retain the entire mass of the sliding portion of the hill.

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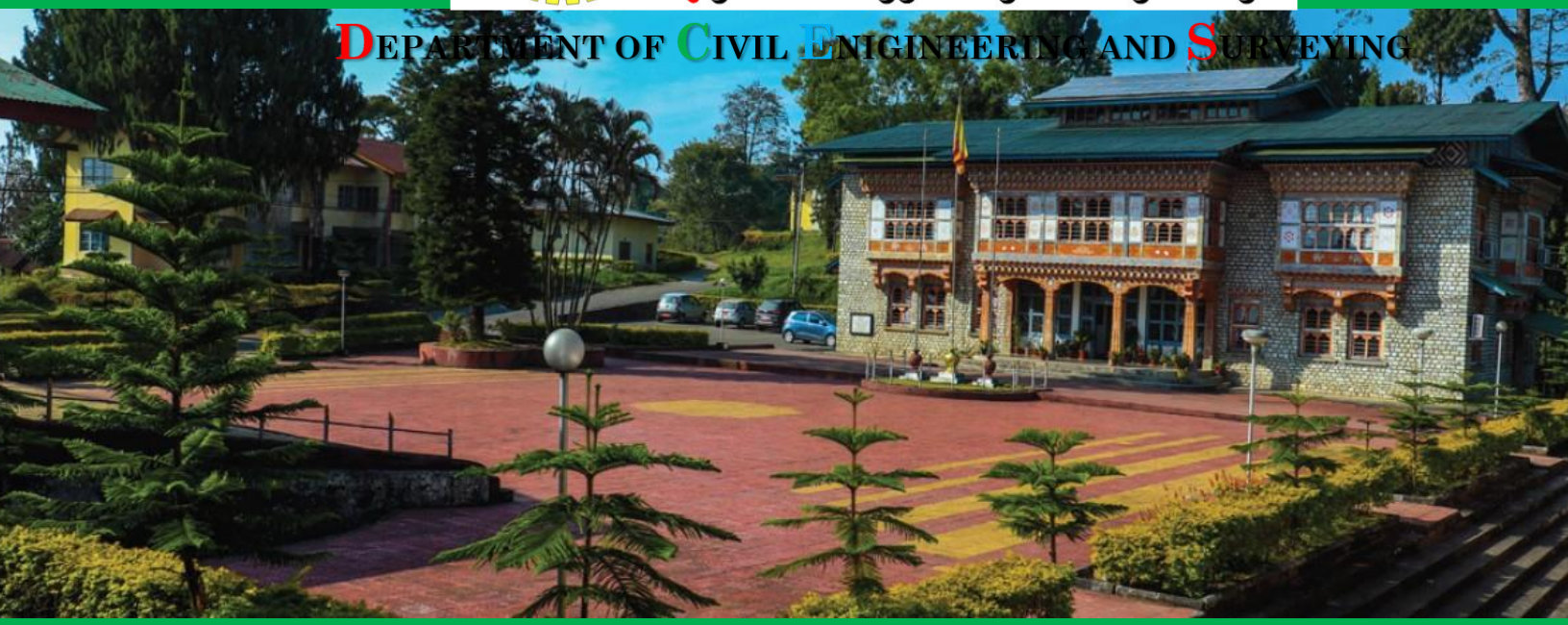

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